Using Entropy and AHP-TOPSIS for Comprehensive Evaluation of Internet Shopping Malls (ISMs) and Solution Optimality

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Abstract

Consumers are switching from offline to online to buy everything due to this reason nowadays Internet shopping malls (ISMs) are setting up a very crucial role in the economy. For assessment and ranking are basically a critical work which could be exploitation of Internet shopping malls information resources when consider in a scientific way, there are many methods for the evaluation and ranking of e-commerce sites. Taking into consideration Traffic Rank, Inbound Links, Competition, Speed, and Keyword Statistics, in literature Multi Criteria Decision Making (MCDM) methods are rarely used by the researchers to find the rank of Internet Shopping Malls (ISMs) on the basis of primary/secondary data of these influencing factors. This study, therefore, is unique to narrow down the gap in literature by employing MCDM methods i.e. Entropy and Analytic Hierarchy Process (AHP) to collect the weight of influencing factors and Technique for Order Preference by Similarity to Ideal (TOPSIS) to find the rank of Internet Shopping Malls (ISMs). After finding out the rank of selected criteria, solution optimality needs to be done to find the average ideal solution matrix. Conclusion and managerial implications of the study are also discussed.

Keywords: Internet shopping malls (ISMs), Entropy, TOPSIS, Traffic Rank, Inbound Links, Competition, Speed, and Keyword Statistics, Analytic Hierarchy Process

Introduction

Internet shopping malls now days have a very crucial role in the economy as the maximum percent of the population prefer to buy from e-commerce sites only (Xiaoshuan et al., 2007; Kumar and Dash, 2015). The Internet shopping malls assessment and ranking are basically a critical work which could be exploitation of Internet shopping malls information resources when consider in a scientific way (Yan and Weijie, 2008). There are just so many methods for the evaluation and ranking of e-commerce sites. Usually there are a few factors use for the evaluation and ranking are traffic rankings, Inbound links (linked sites), competition, page views, speed, and searching through a web search engine (Wang, 2009). The advantages of equitableness, suppleness, accuracy, gumption, and manoeuvre ability are mainly provided by these factors and it can be well used not only for the assessment of different websites but also for the assessment of one website at different period (Merwe and Bekker, 2003; Mention, Martovoy and Torkkeli, 2014). To find the actual position of the Internet shopping malls these five factors assessment methods are the best way and it will also take the development direction of Internet shopping mall website construction (Xiaoshuan et al., 2007; Dash and Kumar, 2014; Railiene, 2015).

Sales somewhere help the e-commerce websites to improve their ranking. Maximum data of these websites represent online sales. However, these data also help the companies to know the customer conversion rate such as lead procurement, account registrations, and requests for information (Wang, 2009). Marketing through search engine has rapidly gained in popularity and it has a huge impact on the Internet shopping malls because of the nature of the traffic it provides (Marx, Vasconcellos and Lara, 2015). Many Internet shopping sites have high click-to conversion rate for traffic searching compared to other forms of online available media, but these sites also pay for the ads on these search engines and advertisers have also seen an increase in the average cost per click for paid search ads (Brooks, 2004). To rank these shopping sites in organic listing, some algorithm can also be used which is very important and help to determine which Internet shopping sites to display and what order will be preferable. Actual characteristic of the web page is only used to rank those web pages and these characteristic is almost used by almost all the search engines (Levene, 2006; Marx, Vasconcellos and Lara, 2015). Ranking of any Internet shopping sites basically depend on the keywords i.e. whether or not some particular words are in URL i.e. uniform resource locator form on that page. Meta-tags, explanation and some words in titles are also embedded on the pages of the websites (Feng et al., 2004). Sometimes a ranking of Internet

Shopping sites depends on the services, i.e. how fast customer's inquiries solved (Watson et al., 1998; Marx, Vasconcellos and Lara, 2015). Where nowadays because of all service available on the internet actually leaves little excuse for any delay in the response by the Internet Shopping sites (Wan, 2000; Railiene, 2015). The main objective of the current study is to do the comprehensive evaluation of internet shopping malls with the help of Entropy and AHP-TOPSIS methods and find out the optimum solution.

The remainder of this study proceeds as follows: the study develops the proposed model in two stages. The first stage draws from existing literature to present well-known factors that somewhere effect the consumer decision while shopping through Internet Shopping Malls and the process of shopping and to form the core of the proposed model. The study then introduces the methodology and the results of the empirical analyses. This part serves to prioritizing the factors. Methodology of this research uses Entropy and AHP-TOPSIS method for the evaluation of the factors. Finally, the study presents concluding remarks and proposes relevant recommendations for practitioners and researchers.

Literature Review

There are many factors which can affect Internet Shopping Malls rank among, the following factors are considered for the compressive evaluation of Internet Shopping Malls (ISMs), in literature these factors are rarely studied by the researchers.

Traffic Rank

Traffic rank of any Internet Shopping sites basically depend on the search engine as search engine help to rank these sites and it has a great impact on the traffic also and on the marketer's website. With the knowledge, Internet Shopping sites use a better equipment to make strategic decisions for the advertising, searching and tactical decisions for some specific or particular keywords. Two factors that help to determine the traffic rank are: Impressions and Click-Through Rate (CTR).

Impressions: Impression came under the criteria where advertisement on the websites is serving as a part of the result of search engine. Impressions are based on the specific words, i.e. how many times a particular keyword is bidding on or searched. Click-through Rate (CTR): CTR is use for the calculation of the traffic rank through what percentage of users or consumer click on a given advertisement listing.

$$\text{CTR} = \frac{Clicks}{Impressions} \tag{1}$$

There are so many other factors that influence Click through rate in addition to rank. These include the title of the products, their description, advertisement relevance, and company name. These variables basically consider at the time of improving the click through rate. First sites need an impression to get a click than someone needs to click on that advertisement.

Inbound Links

Inbound links are also called hyperlink or the back links. These hyperlinks points on the websites of the Internet Shopping sites from the third-party web sites or pages. For SEO *i.e.* Search Engine Optimization these inbound links play a very crucial role because search engine sees these inbound links to the website pages as sign that the content on that website is useful not irrelevant. There are so tools are available that provide service to find these inbound links one of them is Google's Webmaster Tools. Inbound links have never been a problem, but the value of those links to the sites may create a problem as amount of inbound links could be anything. Sometime duplication of data also occurs as the number of inbound links has the same data. As a big organization usually have big websites and these duplications at that time create problems (Dover and Dafforn, 2011).Websites always try to provide correct and appropriate data and always try to manage links like inbound and outbound links to other sites (Pan et al., 2011). A website which have more number of inbound links come into good category and considered to be more valuable and also search engine try to use only iterative process to settlement quality of these links of the websites (Brin and Page, 1998; Langville and Meyer, 2006; Levene, 2006).

Competition

Competition basically defined as the name of the Internet Shopping malls sites and helps to rank the Internet Shopping sites according to it. Snippets are the short advertisement that's showing the contact of the advertisement with the potential customer or visitors and these increases the search results and gives a great and a first impression of the sites. Few specific words have a crucial effect on the Internet Shopping sites as these keywords are searched by the name of the sites. Internet shopping sites try to link the offers with the products and design new product or alter the old ones which are frequently searched by the visitors or could be say searched on the search engine *i.e.* GOOGLE. Internet shopping sites always try to translate or convert the needs of the visitors into the queries as study and understanding the information needs of the customers are always not enough for the business of the Internet shopping sites (Jiang and Zhai, 2007). A long tail shape queries always typed by the users of the search engine, it's always on the search engine to under the need of the users and send to user to the destination that will fulfil their needs (Xiang et al., 2009). And for the Data Management Organization always try to be flexible on these long tail queries (Anderson, 2006). As there could be some niche keywords in the long tail of queries which may offer the Internet Shopping organization to appear more effectively in the market and in future will target the customer community (Anderson, 2006). It is also a main part to anticipate the approaches which are similar and in future it could be adopted by the customer (Lew, 2008). A study conducted also showed that now every Internet Shopping sites adopt the SEO on the same types of words and somewhere paid for the listing will also give the organization businesses an advantage of competitiveness (Sen, 2005). Apart from all these, queries of the user also depend on many other factors, *i.e.* knowledge of individual customers, their experience, Internet usage frequency, stage of decision making etc. (Sen, 2005).

Speed

The interest of a visitor also is affected by the load time of the site. Time taken from any sites to open is the load time. Google analytics are a good tool to find the load time on the sites as Google analytics doesn't ignore any request as at time to analysis it concerns every single second request too. Some request may be a third party request or could be say request came from the third party website which may take time to process. And this thing somewhere affects the interest of the visitors. The quality of a system also helps to measure the functionality of these Internet Shopping sites. System quality measures the functionality of a web site: necessity, opportunity or availability and time of the responses (DeLone and McLean, 2003).Customers who prefer to buy online are very particular about the Internet shopping sites as data on the sites should be easy to read, should always have less load time as well as easy to navigate. For the end-users, highly important sites are that whose load time is less and called responsive site (Robbins and Stylianou, 2003). The design of the pages of the websites should not only focus on the appearance of the sites but also the load time of the sites (Weinberg, 2000). Multimedia, responsiveness and facility these are factors that mattered at the time of measurement of the quality of the system of a web site. Big sites need to be maintained at these sites has big database and without maintenance these sites took time to load. One of the biggest challenges that Internet shopping sites face when user have to wait intolerably long for a shopping sites page to load and sometimes because of these reason users may get switched to the different site or quite using that website (Weinberg, 2000; Kumar and Dash, 2013).

Keyword Statistics

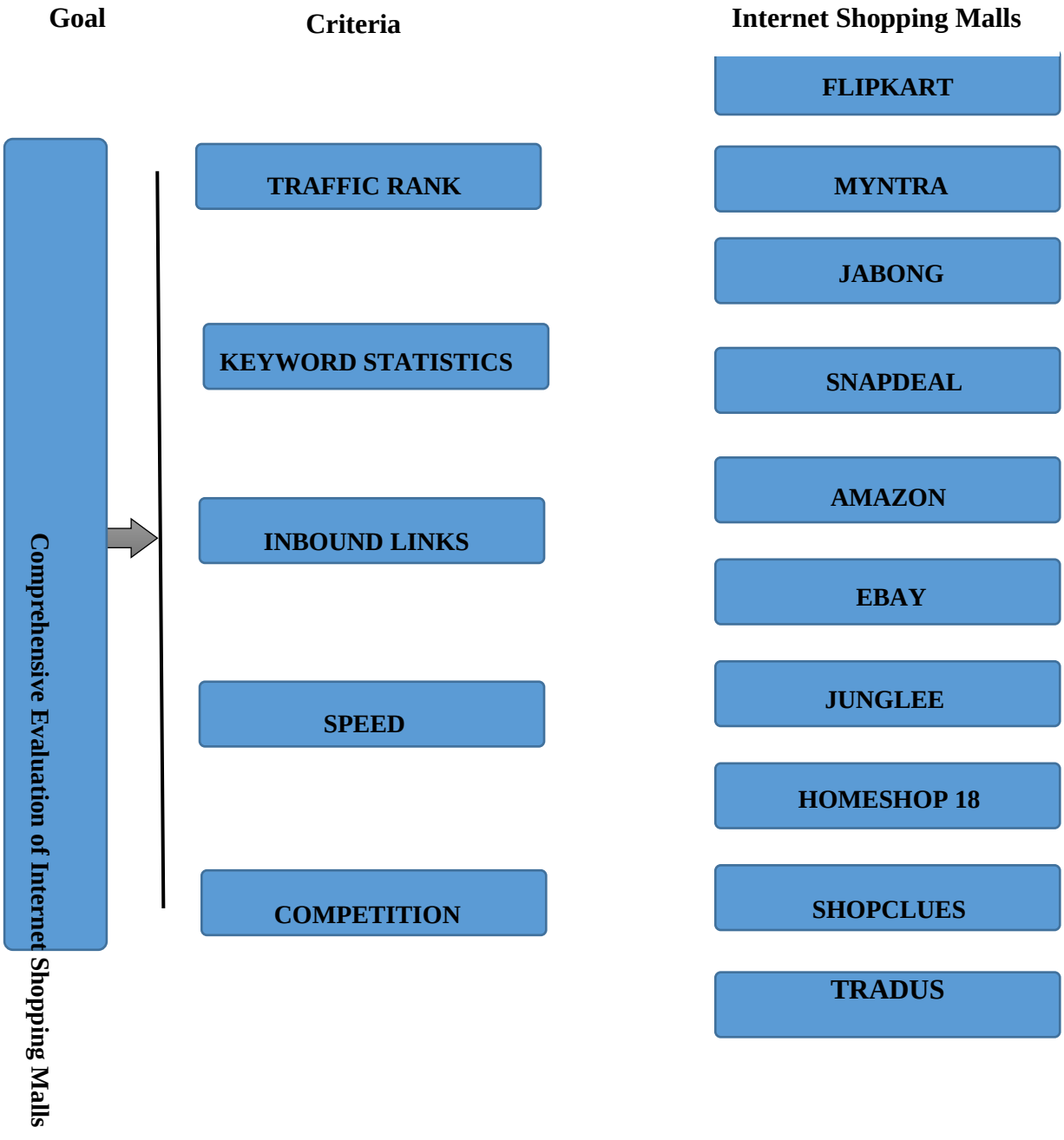
For the keyword statistics again Search engine optimization is the best tool as it provides statistic of the words that usually assist with search engine decisions. Keyword statistic basically works on the keywords which are searched frequently on the major search engines and the in this case took on the daily basis. In this case number took in proportionate not in exact form. Suppose, a keyword is searched around 10,000 times than 5,000 keywords will be considered as total queries will be roughly twice. Competitiveness of each keyword also determines by the click through rate and cost per click. These keywords help to see it search demographics and help to learn about the target audience with the help of these keywords. The following table shows collected data for considered factors.

Table 1: Factors effecting internet shopping malls: a secondary data collection

Sites	Traffic Rank	Keyword Statistic (Daily)	Inbound Link (Google)	Speed (load time in sec)	Competition (Google)
Flipkart	079	5119313	168	2.32	1,78,00,000
Myntra	439	828649	035	0.94	17,10,000
Jabong	191	959254	027	1.38	83,00,000
Snapdeal	190	2008260	049	1.74	1,45,00,000
Amazon	008	295911735	194	1.47	1,39,00,00,000
Ebay	026	312900651	055	4.46	35,80,00,000
Junglee	1414	250234	086	1.32	3,86,00,000
HomeShop18	1,541	529131	020	3.98	12,50,000
Shopclues	663	578008	004	2.68	14,20,000
Tradus	9295	25385	018	2.05	14,00,000

Sources: Traffic Rank: http://www.seomastering.com/google-alexa-rank-checker.php, Keyword Statistic: http://www.seotoolset.com/tools/free_tools.htmlInbound, Links: http://www.seotoolset.com /tools/free_tools.html, Speed: http://tools.pingdom.com/fpt/, Competition: https://www.google.co.in/

Figure 1 Proposed research model



Methodology: Multi Criteria Decision Making (MCDM)

Multi Criteria Decision Making is a collection of methodologies is used for the ranking of the sites, it is also for comparing the sites and selecting multiple alternatives as usually each site have multiple attributes (Kumar and Dash, 2014; Rahmani, Keshavarz, and Rohani, 2014). Payoff matrix, decision matrix and evaluation matrix or evaluation table as MCDM depend on this matrix. MCDM is introduced by the PO-Lung Yu in the year of 1973 also by Milan Zeleny. The steps follows by the Multi Criteria Decision making are: 1) Establishing a criteria for the systematic assessment that relates system goals with the capabilities, 2) Then alternative system develops for goals to be attained, 3) Alternatives will be assisted on the basis of the criteria, 4) Than Normative Multi Criteria method will be applied to the analysis, 5) Alternative will be accepted as an optional, 6) New information will be gathered and jump into the next iteration of optimization if the final solution is not accepted (Whaiduzzaman et al., 2014; Pramod and Banwet, 2014). MCDM consists of two main categories: Multi-Objective decision making: In MODM, objectives are not predetermined, but arise from the optimization. Multi-Attribute decision making: In MADM, objectives are always predetermined, and a small subset is evaluated against a set of attributes. In both these methods, by comparing the ranking of each attribute combination, the best alternative will be chosen (Rehman et al., 2012). For e-commerce site ranking, we required MADM i.e. multi attribute decision making. The methods widely used in MADM are: TOPSIS, VIKOR, AHP, DEMETEL, ELECTRE, and PROMETHEE etc. For the ranking of Internet Shopping Malls (ISMs), both Entropy and TOPSIS methods are used. Entropy method is adopted by this new improved method which helps the traditional method for improvement (Wang, 2009). The mathematical formulation of these two are described as

Mathematics Formulation of Entropy

This method is easily adopted and highly reliable in information measurement. To find the value of the matrix this method begins with the normalization process by using the values of matrix $N=(n_{ij})_{n\times m}$(n alternatives and m indicators) by the following specific formulation:

$$n_{ij}=r_{ij}/\sum_{i=1}^{n} r_{ij} \tag{2}$$

Equation to calculate the entropy measure of every index:

$$E_j=-K\sum_{i=1}^{n}\left[n_{ij}\ln(n_{ij})\right]\forall_j=1,2,\ldots m$$

$$K=\frac{1}{\ln(n)} \tag{3}$$

The degree of divergence d_j of the intrinsic information for each criterion C (j= 1, 2, . . ., n) may be calculated as:

$$d_j=1-E_j \tag{4}$$

The value $d_j$represents the inherent contrast intensity of c_j.The higher the d_j, the more important the criterion $c_j$is forthe problem. The objective weight for each criterion cans be obtained. Accordingly, the normalized weights of indexes may be calculated as:

$$W_j = \frac{d_j}{\sum_{k=1}^{m} d_k} \tag{5}$$

Since E_j is less than or equal to one, the entropy weights are therefore always positive.

Mathematics Formulation of TOPSIS

TOPSIS is an analysis tool introduce in 1981 by Hwang and Yoon. TOPSIS basically used to find the distance between the two ideal solution, i.e. positive ideal solution and negative ideal solution (Wang et al., 2006). From a set of alternatives or attributes, this multi-criteria method is used for identifying the solution and among these alternatives, a solution is found which show the nearness to the ideal solution and far from anti-ideal solution (Wang, 2008). In this technique, the decision matrix is first normalized using vector normalization, and the idealism and anti-ideal solutions are identified within the normalized decision matrix. And further developments are done in 1987 by Yoon and in 1993 by Hwang, Lai and Liu. The benefit criteria in TOPSIS maximizes the benefit in the case of Positive ideal solution and the cost is minimized, whereas in the case of the Negative ideal solution, cost criteria is maximized and benefit criteria are minimized (Wang et al., 2006 and Wang et al., 2007). The weight of the criteria and the ratings of the performance in the TOPSIS process are always given as an exact value (Abo-Sinai and Amer, 2005). The steps that are followed by the TOPSIS model are: 1) First normalized decision matrix is calculated, 2) Then weighted, normalized decision matrix is calculated, 3) In the last Positive Ideal Solution and Negative Ideal Solution is determine. TOPSIS method basically used by the Internet shopping site assessment, but the existing problems in distance calculating and weighing somewhere influence the rationality and dependability of the results, which go against the website development. So, an improved TOPSIS method is proposed which is more reliable and suitable than traditional methods for Internet shopping sites. The assumptions of this method are: 1) Criteria suitability and values should be linearly increasing or decreasing, 2) TOPSIS should be independent in the case of criteria and advantages are: 1) At the time of decision making both the positive and negative criteria should be considered, 2) In the decision process any number of criteria can be applied, and TOPSIS is basically faster and simple then SAW, FDAHP and AHP, FDAHP.

TOPSIS basically used to find the shortest distance with the help of Euclidean distance i.e. farthest from the negative ideal solution and near to the positive ideal solution. TOPSIS procedures can be describing as follows. Set of alternatives, $A = \{A_k | k = 1,\ldots, n\}$, and a set of criteria, $C = \{Cj | j = 1,\ldots, m\}$, where $X = \{x_{kj} | k = 1,\ldots, n; j = 1,\ldots, m\}$ denotes the set of performance ratings and $w = \{w_j | j = 1,\ldots, m\}$ is the weights set, the information table $I = (A, C, X, W)$ can be represented as shown in Table 2. The first step of TOPSIS is to calculate normalized ratings by

Step 1

$$r_{kj}(x) = \frac{x_{kj}}{\sqrt{\sum_{i=0}^{n} x_{kj}^2}} \tag{6}$$

Step 2

• Benefit criteria (larger is better), $r_{kj}(x) = ¿$, where $x_j^{¿} = \max_k x_{kj}$ and $x_j^{-¿ = \min_k x_{kj} ¿}$ or setting $x_j^{¿}$ is the desired/aspired level and $x_{¿_j}$.

• For cost criteria (smaller is better), $r_{kj}(x) = ¿$, and then to calculate weighted normalized ratings by

$$v_{kj}(x)=w_j r_{kj}(x), k=1,\ldots,n; j=1,\ldots,m. \quad (7)$$

Next the NIS and PIS point are derived as:

$PIS=A^{+¿=¿¿}$

$$¿\left\{\left(\max_k v_{kj}(x)\middle| j\in J_1\right),\left(\min_k v_{kj}(x)\middle| j\in J_2\right)\vee k=1,\ldots,n\right\} \quad (8)$$

Table 2: The information table of TOPSIS

Alternatives	C_1	C_2	…	C_m
A_1	x_{11}	x_{21}	…	x_{2m}
A_2	x_{21}	x_{22}	⋯	x_{2m}
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
A_n	x_{n1}	x_{n2}	⋯	x_{nm}
W	W_1	W_2	⋯	W_m

$$NIS=A^{-¿=¿¿}$$

$$¿\left\{\left(\min_k v_{kj}(x)\vee j\in J_1\right),\left(\max_k v_{kj}(x)\vee j\in J_2\right)\vee k=1,\ldots..,n\right\} \quad (9)$$

Where J_1 and J_2 are the benefit and the cost attributes, respectively.

Step 3: To calculate separation from the Positive idea solution and Negative ideal solution between the alternatives, with the help of Euclidean distance method by Eq. (10)-(11), which are given as:

$$D_k^{¿}=\sqrt{\sum_{j=1}^{m} ¿¿¿¿} \quad (10)$$

and

$$D_k^{-¿=\sqrt{\sum_{j=1}^{m} ¿¿¿¿¿}} \quad (11)$$

The similarities to the PIS can be derived as:

$$C_k^{¿}=\frac{D_k^{-¿}}{¿¿}¿ \quad (12)$$

Where $C_k^{i} \in [0,1] \forall k - 1, \ldots\ldots, n.$

Now, by seeing the similarities to Positive Ideal Solution $\left(C_k^{i}\right)$ preferred order can be obtain and to choose the beast alternatives this order has to be in descending order.

Mathematical Formulation of AHP

AHP has been developed by Saaty (1980). There are *i* alternatives of the problem, namely A_1, A_2… A_i. In addition, there are n judging criteria C_1, C_2… C_n. One important step in AHP analysis is to conduct pair wise comparisons between the criteria. Assume w_{ij} is such relative weighting of Criterion *i* over Criterion *j*, and that no interdependency exists among the criteria, the relative weighting of Criterion *j* over Criterion *i* would then be $1/w_{ij}$. Therefore, we can construct a reciprocal matrix A in the following form.

$$A = \begin{bmatrix} 1 & w_{12} & . & . & . & w_{1n} \\ 1/w_{12} & 1 & . & . & . & w_{2n} \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ 1/w_{1n} & 1/w_{2n} & . & . & . & 1 \end{bmatrix} \qquad (13)$$

The above matrix can be rewritten in the following form:

$$A = \begin{bmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & . & . & . & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & . & . & . & \frac{w_2}{w_n} \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & . & . & . & \frac{w_n}{w_n} \end{bmatrix} \qquad (14)$$

where w_i are the actual weightings of each criterion. A matrix of this form is also consistent because $w_{jk} = w_{ik}/w_{ij}$ for all $i, j, k = 1 \ldots n$ (Saaty 1980). If we multiply the matrix by its weighting vector $w = [w_1 \ldots w_n]$ T, then obtains the following linear equation:

$$A = \begin{bmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & . & . & . & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & . & . & . & \frac{w_2}{w_n} \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & . & . & . & \frac{w_n}{w_n} \end{bmatrix} \begin{bmatrix} w_1 \\ . \\ . \\ . \\ w_n \end{bmatrix} = n \begin{bmatrix} w_1 \\ . \\ . \\ . \\ w_n \end{bmatrix} \qquad (15)$$

Or (A - *n*I) *w* = 0. We can find a non-trivial solution on *w* if *n* is an eigen value of A. Since the rank of A is 1 as all rows are multiplied by any one of the rows, there is only 1 eigen value. The sum of all eigen values of A equals to its trace which is *n*; therefore, *n* is an eigen value of A and the elements of the weights vector expresses as follows:

$$w_i = \frac{1}{n}\sum_{j=1}^{n} w_{ij} w_j \qquad (16)$$

In reality, the relative weightings (w_{ij}) are estimated values only; otherwise, we do not need to calculate (or estimate to be precise) the weights vector. In the literature a scale of 1 to 9 (or just the odd numbers) to represent the importance of criterion *i* over criterion *j* is used. In other words, the reverse scale (1/9…1) is employed to show the negative relationship. This poses a problem on the accuracy of the pair wise comparison as only discrete values are used. To tackle above problem, Saaty (1980) introduced the concept of consistency ratio. The concept is very straightforward. If there is any error due to inconsistency, the following value would be non-zero:

$$\lambda_{max} - n = -\sum_{i=1}^{n} \lambda_i \qquad (17)$$

where $\lambda_{max} = \lambda_1, \ldots \lambda_{i,} i = ¿$ 1; . . .; *n* are the eigen values of A.
Since λ_{max} = *n* represents the ideal case, Saaty (1980) suggested that Consistency Index (*CI*) can be calculated, using the following formula (Saaty, 1980):

$$CI = (\lambda ¿¿ max - n)/(n-1) ¿ \qquad (18)$$

In other words, *CI* is a measure of the deviation of λ_{max} from *n*. Based on the above, it can also be noted that there are (n^2-*n*)/2 comparisons need to be made in order to construct the matrix. Above discussion is a brief introduction to one level of hierarchical structure. The analysis can be extended to a full hierarchy of many levels. Of course, the more levels of the hierarchical model are involved, the more comparisons are needed, and using the final Consistency Ratio (*CR*) can conclude whether the evaluations are sufficiently consistent. The *CR* is calculated as the ratio of the *CI* and the Random Index (*RI*) *n* values of random index of Saaty (1980). The number 0.1 is the accepted upper limit for *CR*. If the final consistency ratio exceeds this value, the evaluation procedure has to be repeated to improve consistency.

$$CR = \frac{CI}{RI} \qquad (19)$$

Analysis

On the basis of the Equations (2) - (5), the weight matrix of factors as follows:

[ ]

Vector normalization methods for TOPSIS used to normalized decision matrix with the below formula. Here *k* denotes the number of alternatives (e-commerce sites) and *j*, denotes number of criteria.

$$r_{kj}(x) = \frac{x_{kj}}{\sqrt{\sum_{i=0}^{n} x_{kj}^2}}$$

Table 3: Normalize matrix

Sites	Traffic Rank	Keyword Statistic (Daily)	Inbound Link (Google)	Speed (load time in sec)	Competition (Google)

Flipkart	0.008260	0.011886010	0.588927	0.294119	0.012394755
Myntra	0.045898	0.001923956	0.122693	0.119296	0.001190732
Jabong	0.019969	0.002227194	0.094649	0.174950	0.005779577
Snapdeal	0.019865	0.004662774	0.171770	0.220589	0.010096851
Amazon	0.000836	0.687047251	0.680070	0.186360	0.967904993
Ebay	0.002718	0.726492081	0.192803	0.565418	0.249287761
Junglee	0.147836	0.000580993	0.301474	0.167343	0.026878513
HomeShop18	0.161114	0.001228535	0.070110	0.504566	0.000870418
Shopclues	0.069318	0.001342018	0.014022	0.339758	0.000988795
Tradus	0.971805	0.000058938	0.063099	0.259889	0.000974868

To find the weighted normalized decision matrix we need to multiply weight with each column.

$$v_{kj}(x) = w_j r_{kj}(x), k = 1, \ldots, n; j = 1, \ldots\ldots, m.$$

Table 4: Weighted normalized decision matrix

Sites	Traffic Rank	Keyword Statistic (Daily)	Inbound Link (Google)	Speed (load time in sec)	Competition (Google)
Flipkart	0.002916195	0.018348498	-0.13589	-0.13471	0.008526396
Myntra	0.016205183	00.00297002	-0.02831	-0.05464	0.000819109
Jabong	0.007050547	0.003438131	-0.02184	-0.08013	0.003975791
Snapdeal	0.007013633	0.007197949	-0.03964	-0.10103	0.006945662
Amazon	0.000295311	1.060598535	-0.15692	-0.08536	0.665825323
Ebay	00.00095976	01.12148973	-0.04449	-0.25897	0.171485947
Junglee	0.052196195	0.000896882	-0.06956	-0.07665	0.018489826
HomeShop18	0.056884255	0.001896496	-0.01618	-00.2311	0.000598764
Shopclues	0.024473888	00.00207168	-0.00324	-0.15561	0.000680196
Tradus	0.343114307	0.000090984	-0.01456	-0.11903	0.000670615

Next positive idea solution is $A^{+¿=¿¿}$0.000295311, 1.12148973, -0.00324, -0.25897, 0.665825323
Negative Ideal Solution is: $A^{-¿¿}$= 0.343114307, 0.000090984204466, -0.15692-0.05464, 0.000598764

Now we have ideal solution and negative ideal solution we should try to find out the distance of alternative from these solutions. So there would be 2 distances; distance from ideal solution and distance from negative-ideal solution.

$$D_k^{¿} = \sqrt{\sum_{j=1}^{m} ¿¿¿¿}$$

Table 4: Distance from positive ideal solution

S. No.	Site Name	$D^{+¿¿}$
1	Flipkart	1.682007942
2	Myntra	1.735952787
3	Jabong	1.720459927
4	Snapdeal	1.702082853
5	Amazon	0.057470279
6	Ebay	0.24607371
7	Junglee	1.715107085
8	HomeShop18	1.700162003
9	Shopclues	1.706781872
10	Tradus	1.83720141

S. No.	Site Name	$D^{-¿¿}$
1	Flipkart	0.122984751
2	Myntra	0.123419418
3	Jabong	0.131859164
4	Snapdeal	0.128963643
5	Amazon	1.685671005
6	Ebay	1.458200422
7	Junglee	0.093070205
8	HomeShop18	0.132878797
9	Shopclues	0.135352098
10	Tradus	0.024414403

$D_k^{-¿=\sqrt{\sum_{j=1}^{m} ¿¿¿¿¿}}$

Table 5: Distance from negative ideal solution

Now at the last step, we have distances from ideal solutions, we would calculate ratio for each alternative through the below formula. $C_k^¿$ represents closeness of the alternative from the ideal solution. On the basis of $C_k^¿$ we can rank these alternatives

$$C_k^¿=\frac{D_k^{-¿}}{¿¿}¿$$

Where $C_k^¿ \in [0,1] \forall k-1,\ldots..,n.$

Table 6: Ranking through Entropy and TOPSIS: a secondary data study

S. No.	Site Name	TOPSIS $C_k^¿$	Rank
1	Flipkart	0.0681	7
2	Myntra	0.0664	8

3	Jabong	0.0712	5
4	Snapdeal	0.0704	6
5	Amazon	0.9670	1
6	Ebay	0.8556	2
7	Junglee	0.0515	9
8	HomeShop18	0.0725	4
9	Shopclues	0.0735	3
10	Tradus	0.0131	10

Solution optimality

To give the more reliable and optimum solution, again the primary data has been collected through personal interview from the Experts from industry persons and the experts those have working that field on the basis of their experience and research work. The data have been collected and synthesized in Microsoft Excel and then analyzed. Let C = {*Cj| j= 1, 2... n*} be the set of decision criteria, Analytical Hierarchy Process (AHP) is used to find the weight of influencing factors, the value of output result is given in Table 7 which that the weight of each factor and consistency value of the data. Table 7 shows the output result of AHP of basis of collected experts' opinions.

Table 7 Five criteria weight and related parameter values

Criteria	**Traffic Rank** (C_1)	**Keyword Statistic** (C_2)	**Inbound Link (Google)** (C_3)	**Speed (load time in sec)** (C_4)	**Competition (Google)** (C_5)
Weight	0.21	0.20	0.21	0.21	0.18
λ_{max}			5.13		
CI			0.02		
RI			1.12		
CR			0.03		

After collect the weight of influencing factors again Equations 6-12 are used to find the rank of factor on primary data. Table 8 shows the rank of criteria after applying AHP-TOPSIS.

Table 8: Ranking through AHP -TOPSIS

S. No.	**Site Name**	**TOPSIS** $C_k^{¿}$	**Rank**
1	Flipkart	0.5456	3
2	Myntra	0.4333	5
3	Jabong	0.4284	7
4	Snapdeal	0.4398	4
5	Amazon	0.9978	1
6	Ebay	0.6550	2
7	Junglee	0.4285	6
8	HomeShop18	0.2910	10
9	Shopclues	0.3552	9
10	Tradus	0.0371	8

Both solutions have different ranks on the basis of secondary data and primary data and their selected criteria but solution optimize with average of the solutions by the below given formula

$$Solution\,Optimality\left(FC¿¿k^{¿}\right)=\left(\frac{C_k^{¿}+AC_k^{¿}}{2}\right)¿$$

Table 9 shows that optimal solution of both the secondary and primary data analysis after using above education and provide the final solution for the study.

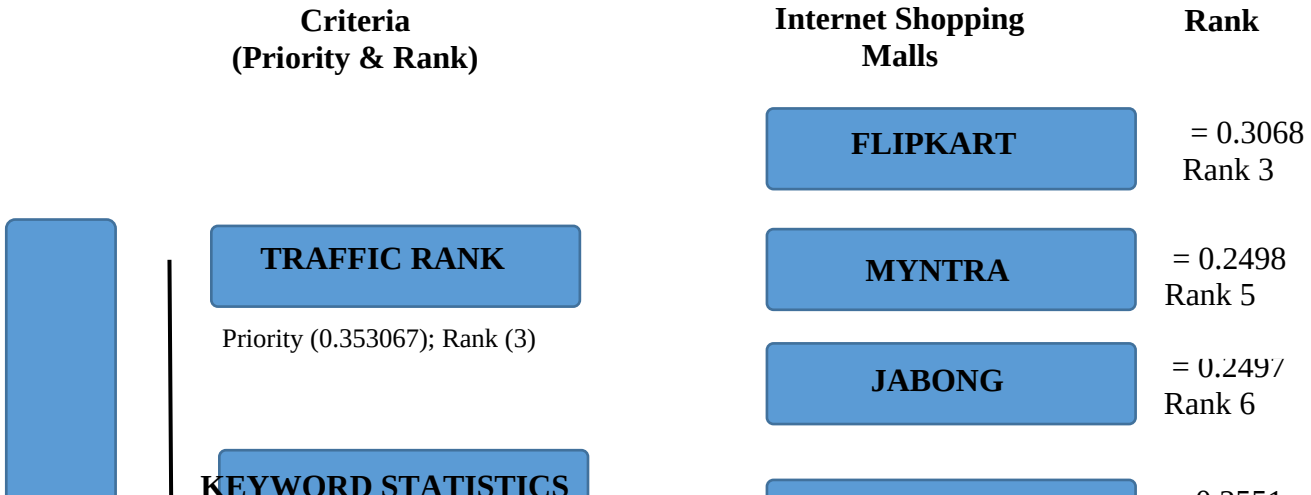
Table 9: Average idea solution matrix

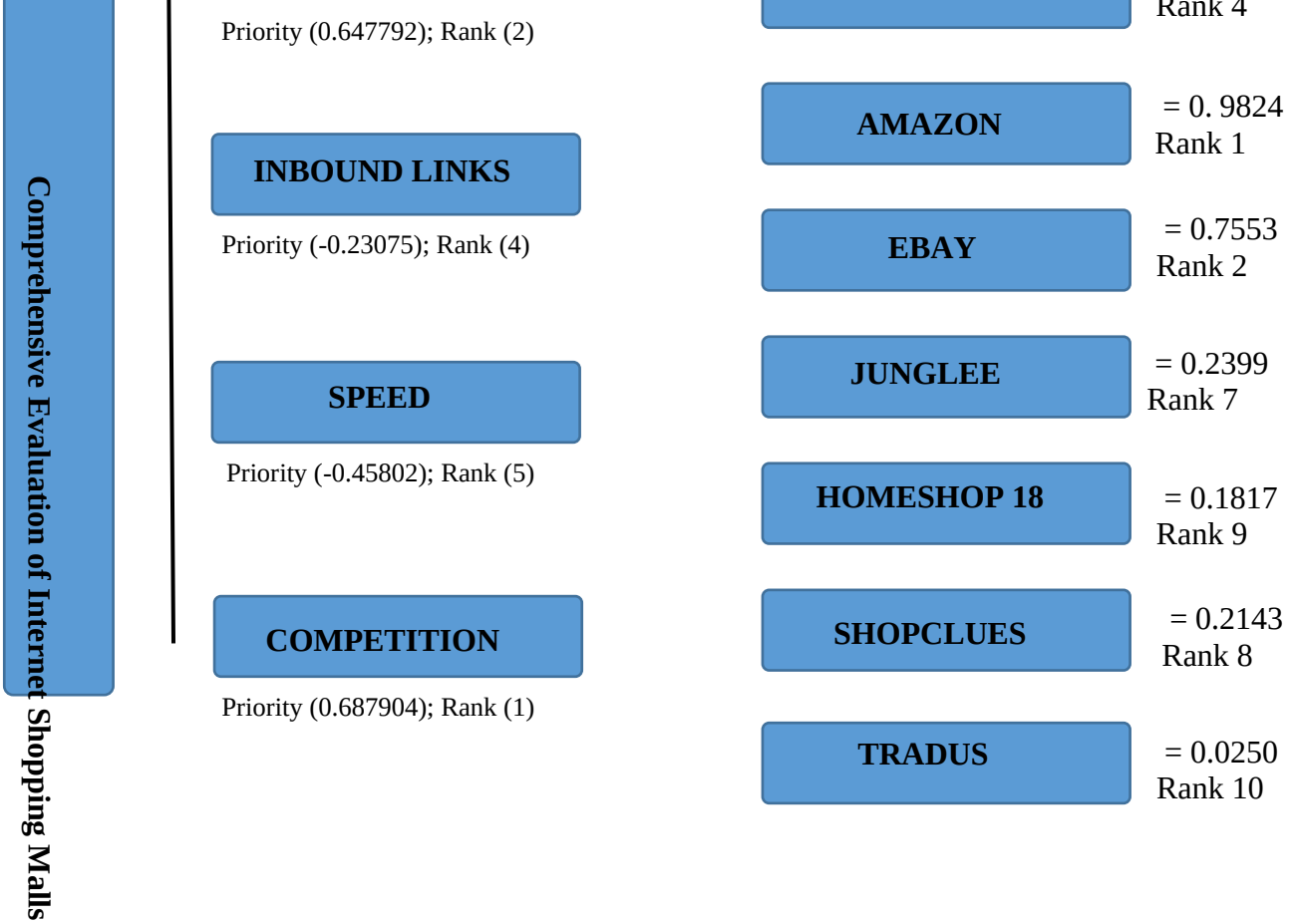
S. No.	Site	TOPSIS FC_k^i	Final Rank
1	**Flipkart**	0.306888	3
2	**Myntra**	0.249845	5
3	**Jabong**	0.249790	6
4	**Snapdeal**	0.255133	4
5	**Amazon**	0.982398	1
6	**Ebay**	0.755291	2
7	**Junglee**	0.239974	7
8	**HomeShop18**	0.181721	9
9	**Shopclues**	0.214339	8
10	**Tradus**	0.025090	10

Conclusion and implications

The aim of this research is to develop a TOPSIS model to evaluate different shopping website and to support the selection of priority mix that is efficient. These factors are to produce a final evaluation ranking for priority among these shopping websites of the proposed model. To achieve the objectives of the study both secondary and primary data are collected and did the comparative analysis. The solution optimality is achieved by average the ideal solution matrix. Of the proposed method, Entropy, AHP and TOPSIS, we find out that Competition (Google), Keyword Statistic (Daily) and Traffic Rank are the most important for improving the competitive advantage of shopping website. Moreover, the Amazon.com and Ebay.com rank the first two positions for shopping websites. From a theoretical perspective, this research developed a model for evaluation of Internet Shopping Malls as given in Figure 2. The study ranked the shopping websites on the basis of identified factors from an extensive literature review. Technique for order preference by similarity to ideal solution (TOPSIS) is utilized to achieve the objective of the study. The findings of study show that Amazon.com is in top position. As it is called Amazon of Indian e-Commerce it has gained a huge reputation and maintained a better quality. Score of Amazon.com is much higher than rest websites. On the 2nd position we have Ebay.com, which is a fashion, electronics and apparel website as they don't sell the product by themselves, they provide a platform for the seller to sell their product. Amazon has gained a huge reputation outside India and is functioning in many countries. So they applied the same business model in India and become successful in penetrating Indian e-Commerce market. Though Amazon does not sell products themselves, but their centralized reputation are much better than others. Shopclues.com is a striving player. It is widening its business in a very short interval of time. Our study demonstrates that it does not far from Amazon. So Shopclues.com needs to improve their Reputation system and other elements to become a successful player. In the last three positions we have are Myntra.com, Junglee.com and Tradus.com. There website quality is also lacking behind other websites. So overall it damages the rank among other top websites. These sites need to do innovation so that it can attract more and more customers. In the end, Amazon.com has a vast product line. It gets maximum visitors and customers as well.

Figure 2: Rank of internet shopping malls





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